PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

United States Patent and Trademark Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 31 July 1997 (31.07.97)	
International application No. PCT/GB96/03195	**Applicant's or agent's file reference** EH/41734
International filing date (day/month/year) 20 December 1996 (20.12.96)	**Priority date** (day/month/year) 21 December 1995 (21.12.95)
Applicant EMBLETON, Jonathan, Kenneth et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

17 July 1997 (17.07.97)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Céline Faust
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TR. .TY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

HITCHCOCK, Esmond, Antony
Lloyd Wise, Tregear & Co.
Commonwealth House
1-19 New Oxford Street
London WC1A 1LW
ROYAUME-UNI

Date of mailing (day/month/year)
09 June 1998 (09.06.98)

Applicant's or agent's file reference
EH/41734

IMPORTANT NOTIFICATION

International application No.
PCT/GB96/03195

International filing date (day/month/year)
20 December 1996 (20.12.96)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address
R.P. SCHERER LIMITED
Frankland Road
Blagrove
Swindon
Wiltshire SN5 8YS
United Kingdom

State of Nationality: GB
State of Residence: GB
Telephone No.:
Facsimile No.:
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [X] the name [X] the address [X] the nationality [X] the residence

Name and Address
PHARMACIA & UPJOHN AB
Lindhagensgatan 13
S-112 87 Stockholm
Sweden

State of Nationality: SE
State of Residence: SE
Telephone No.:
Facsimile No.:
Teleprinter No.:

3. Further observations, if necessary:
Power of attorney authorizing HITCHCOCK, Esmond, Antony to represent the applicant PHARMACIA & UPJOHN AB is required.

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

Authorized officer
M. Abidine
Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

HITCHCOCK, Esmond A.
LLOYD WISE, TREGEAR & CO.
Commonwealth House
1-19 New Oxford Street
London WC1A 1LW
GRANDE BRETAGNE

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	03.06
Applicant's or agent's file reference: EH/41734	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB96/03195	20/12/1996	21/12/1995

Applicant: R.P. SCHERER LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Edel, M Tel. (+49-89) 2399-2426

Form PCT/IPEA/416 (July 1992)

41734

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference EH/41734	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (PCT/IPEA/416)
International application No. PCT/GB96/03195	International filing date *(day/month/year)* 20/12/1996	Priority date *(day/month/year)* 21/12/1995
International Patent Classification (IPC) or national classification and IPC A61F9/00		
Applicant R.P. SCHERER LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

I	☒	Basis of the report
II	☐	Priority
III	☒	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	☐	Lack of unity of invention
V	☒	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	☐	Certain documents cited
VII	☒	Certain defects in the international application
VIII	☒	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
17/07/1997	23. 12. 98
Name and mailing address of the IPEA/ European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer Lega D'Incecco, A.M. Telephone No. (+49-89) 2399-2339

Form PCT/IPEA/409 (Cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB96/03195

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-14 as originally filed

Claims, No.:

1-15 as originally filed

Drawings, sheets:

1/1 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 9-11.

because:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB96/03195

☐ the said International application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☒ no international search report has been established for the said claims Nos. 9-11.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	4, 5, 6, 12, 13, 14, 15
	No:	Claims	1, 2, 3, 7, 8
Inventive step (IS)	Yes:	Claims	
	No:	Claims	4, 5, 6, 12, 13, 14, 15
Industrial applicability (IA)	Yes:	Claims	1-8, 12-15
	No:	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB96/03195

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

V.

1. Reference is made to the following document:

D1 = EP-A-0 224 352.

2. The present application does not satisfy the criterion set forth in Article 33(2) PCT because the subject-matter of claims 1, 2, 3, 7 and 8 is not new in respect of prior art as defined in the regulations (Rule 64(1)-(3) PCT) for the following reasons:

2.1 Document D1 discloses (cf. abstract; page 12, lines 5-20; claims 9 and 14; figures 1 and 2) a dosage form useful in ophthalmic treatment comprising a jet or stream of droplets of treatment fluid, each droplet having an ophthalmologically active compound in suspension or solution.

2.2 Document D1 (cf. abstract; page 3, line 33 - page 4, line 7; page 12, lines 5-20; page 13, lines 18-27; figures 1 and 2) discloses also all the features of dependent claims 2, 3, 7 and 8.

3. The present application does not satisfy the criterion set forth in Article 33(3) PCT because the subject-matter of independent claim 12 and dependent claims 4, 5, 6, 13, 14 and 15 does not involve an inventive step (Rule 65(1)(2) PCT for the following reasons:

3.1 Independent claim 12:
Document D1, which is considered to represent the most relevant state of the art, discloses (cf. abstract, page 13, lines 18-27; claim 1) a method of increasing the ocular bioavailability of ophthalmologically active compound from which the subject-matter of claim 12 differs in that the droplets have a mean diameter in the range 20μm to 1000μm.

However, since the quantity of substance sprayed with the apparatus of D1 is of 5μl, and the compound in solution is atomized as a spray of droplets, the method disclosed in D1 is suitable for spraying droplets in the above mentioned range.

3.2 Dependent claims 4, 5, 6, 13, 14 and 15:

a. Both the apparatus and the method discloses in D1 are suitable for spraying a jet or stream of droplets of treatment fluid having the features of claims 4, 5, 6 and 13.

b. Furthermore the apparatus sprays a jet or stream of droplets corresponding to 5µl (cf. page 13, lines 18-27). Thus the features of claims 14 and 15 are already disclosed in D1.

VII.

1. The reference to the documents WO-A-96/00050 and WO-A-96/06581 will have to be delated in some cases when entering the National or Regional Phase, e.g. EPO.

2. Independent claims 1 and 12 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in a preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in a characterising part (Rule 6.3(b)(ii) PCT).

3. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

VIII.

1. Claims 3 and 4 do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claims attempt to define the subject-matter in terms of the result to be achieved which merely amounts to a statement of the underlying problem. The technical features necessary for achieving this result should be added.
It is to be noted that these features are already present in claims 5 and 6.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
EH/41734		
International application No.	International filing date (day/month/year)	(Earliest) Priority Date (day/month/year)
PCT/GB 96/03195	20/12/1996	21/12/1995
Applicant		
R.P. SCHERER LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. [X] **Certain claims were found unsearchable** (see Box I).

2. [ ] **Unity of invention is lacking** (see Box II).

3. [ ] The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing
   - [ ] filed with the international application.
   - [ ] furnished by the applicant separately from the international application,
     - [ ] but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
   - [ ] Transcribed by this Authority

4. With regard to the **title,**
   - [X] the text is approved as submitted by the applicant.
   - [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**
   - [X] the text is approved as submitted by the applicant.
   - [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:
   Figure No. _____
   - [ ] as suggested by the applicant.
   - [ ] because the applicant failed to suggest a figure.
   - [ ] because this figure better characterizes the invention.
   - [X] None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 96/03195

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: 9-11
because they relate to subject matter not required to be searched by this Authority, namely:
SEE RULE 39.1 (iv) PCT

2. [ ] Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. [ ] As all searchable claims could be searches without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

09/091958 20

PATENT COOPERATION TREATY

PCT 30 MAR 1998

WIPO PCT

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (PCT/IPEA/416)
EH/41734		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB96/03195	20/12/1996	21/12/1995
International Patent Classification (IPC) or national classification and IPC		
A61F9/00		
Applicant		
R.P. SCHERER LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

I	☒	Basis of the report
II	☐	Priority
III	☒	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	☐	Lack of unity of invention
V	☒	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	☐	Certain documents cited
VII	☒	Certain defects in the international application
VIII	☒	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
17/07/1997	20.[illegible]
Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Lega D'Incecco, A.M. Telephone No. (+49-89) 2399-2339

Form PCT/IPEA/409 (Cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB96/03195

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-14 as originally filed

Claims, No.:

1-15 as originally filed

Drawings, sheets:

1/1 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 9-11.

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☒ no international search report has been established for the said claims Nos. 9-11.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 4, 5, 6, 12, 13, 14, 15
	No:	Claims 1, 2, 3, 7, 8
Inventive step (IS)	Yes:	Claims
	No:	Claims 4, 5, 6, 12, 13, 14, 15
Industrial applicability (IA)	Yes:	Claims 1-8, 12-15
	No:	Claims

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

V.

1. Reference is made to the following document:

   D1 = EP-A-0 224 352.

2. The present application does not satisfy the criterion set forth in Article 33(2) PCT because the subject-matter of claims 1, 2, 3, 7 and 8 is not new in respect of prior art as defined in the regulations (Rule 64(1)-(3) PCT) for the following reasons:

2.1 Document D1 discloses (cf. abstract; page 12, lines 5-20; claims 9 and 14; figures 1 and 2) a dosage form useful in ophthalmic treatment comprising a jet or stream of droplets of treatment fluid, each droplet having an ophthalmologically active compound in suspension or solution.

2.2 Document D1 (cf. abstract; page 3, line 33 - page 4, line 7; page 12, lines 5-20; page 13, lines 18-27; figures 1 and 2) discloses also all the features of dependent claims 2, 3, 7 and 8.

3. The present application does not satisfy the criterion set forth in Article 33(3) PCT because the subject-matter of independent claim 12 and dependent claims 4, 5, 6, 13, 14 and 15 does not involve an inventive step (Rule 65(1)(2) PCT for the following reasons:

3.1 Independent claim 12:
Document D1, which is considered to represent the most relevant state of the art, discloses (cf. abstract, page 13, lines 18-27; claim 1) a method of increasing the ocular bioavailability of ophthalmologically active compound from which the subject-matter of claim 12 differs in that the droplets have a mean diameter in the range 20μm to 1000μm.

However, since the quantity of substance sprayed with the apparatus of D1 is of 5μl, and the compound in solution is atomized as a spray of droplets, the method disclosed in D1 is suitable for spraying droplets in the above mentioned range.

3.2 Dependent claims 4, 5, 6, 13, 14 and 15:

a. Both the apparatus and the method discloses in D1 are suitable for spraying a jet or stream of droplets of treatment fluid having the features of claims 4, 5, 6 and 13.

b. Furthermore the apparatus sprays a jet or stream of droplets corresponding to 5µl (cf. page 13, lines 18-27). Thus the features of claims 14 and 15 are already disclosed in D1.

VII.

1. The reference to the documents WO-A-96/00050 and WO-A-96/06581 will have to be delated in some cases when entering the National or Regional Phase, e.g. EPO.

2. Independent claims 1 and 12 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in a preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in a characterising part (Rule 6.3(b)(ii) PCT).

3. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

VIII.

1. Claims 3 and 4 do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claims attempt to define the subject-matter in terms of the result to be achieved which merely amounts to a statement of the underlying problem. The technical features necessary for achieving this result should be added.
   It is to be noted that these features are already present in claims 5 and 6.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 96/03195

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61F9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 224 352 A (IMPERIAL CHEMICAL INDUSTRIES PLC) 3 June 1987 see abstract; figures see page 13, line 18-27 see page 12, line 5-20	1-8, 12-15
X	US 4 158 361 A (THE RISDON MANUFACTURING COMPANY) 19 June 1979 see the whole document	1-4

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search	Date of mailing of the international search report
17 March 1997	27.03.97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Steenbakker, J

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 96/03195

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 224352 A	03-06-87	AU 600684 B	23-08-90
		AU 6453486 A	21-05-87
		CA 1296629 A	03-03-92
		JP 2541527 B	09-10-96
		JP 62142110 A	25-06-87
		US 4952212 A	28-08-90
		US 5053000 A	01-10-91
US 4158361 A	19-06-79	NONE	

09/091958

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A61F 9/00

A1

(11) International Publication Number: WO 97/23177

(43) International Publication Date: 3 July 1997 (03.07.97)

(21) International Application Number: PCT/GB96/03195

(22) International Filing Date: 20 December 1996 (20.12.96)

(30) Priority Data:
9526150.9 21 December 1995 (21.12.95) GB

(71) Applicant *(for all designated States except US)*: R.P. SCHERER LIMITED [GB/GB]; Frankland Road, Blagrove, Swindon, Wiltshire SN5 8YS (GB).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: EMBLETON, Jonathan, Kenneth [GB/GB]; 4 Beaufort Court, Chesterton Lane, Cirencester GL7 1WJ (GB). MALCOLMSON, Richard, Joseph [GB/GB]; 9 Ashburnham Close, Freshbrook, Swindon SN5 8RA (GB). MARTINI, Luigi, Gerard, Anthony [GB/GB]; 7 Dunsters Mead, Welwyn Garden City, Herts AL7 3JW (GB).

(74) Agent: HITCHCOCK, Esmond, Antony; Lloyd Wise, Tregear & Co., Commonwealth House, 1-19 New Oxford Street, London WC1A 1LW (GB).

(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published

With international search report.

(54) Title: OPHTHALMIC TREATMENT

(57) Abstract

The bioavailability of an ophthalmologically active compound is increased by its provision in a dosage of ophthalmic treatment liquid which takes the form of a jet or stream of droplets. Such a jet or stream can be directed or targeted at a particular site in the eye where the compound can be best absorbed.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	**GB**	United Kingdom	**MW**	Malawi
AT	Austria	**GE**	Georgia	**MX**	Mexico
AU	Australia	**GN**	Guinea	**NE**	Niger
BB	Barbados	**GR**	Greece	**NL**	Netherlands
BE	Belgium	**HU**	Hungary	**NO**	Norway
BF	Burkina Faso	**IE**	Ireland	**NZ**	New Zealand
BG	Bulgaria	**IT**	Italy	**PL**	Poland
BJ	Benin	**JP**	Japan	**PT**	Portugal
BR	Brazil	**KE**	Kenya	**RO**	Romania
BY	Belarus	**KG**	Kyrgystan	**RU**	Russian Federation
CA	Canada	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SG**	Singapore
CH	Switzerland	**KZ**	Kazakhstan	**SI**	Slovenia
CI	Côte d'Ivoire	**LI**	Liechtenstein	**SK**	Slovakia
CM	Cameroon	**LK**	Sri Lanka	**SN**	Senegal
CN	China	**LR**	Liberia	**SZ**	Swaziland
CS	Czechoslovakia	**LT**	Lithuania	**TD**	Chad
CZ	Czech Republic	**LU**	Luxembourg	**TG**	Togo
DE	Germany	**LV**	Latvia	**TJ**	Tajikistan
DK	Denmark	**MC**	Monaco	**TT**	Trinidad and Tobago
EE	Estonia	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**UG**	Uganda
FI	Finland	**ML**	Mali	**US**	United States of America
FR	France	**MN**	Mongolia	**UZ**	Uzbekistan
GA	Gabon	**MR**	Mauritania	**VN**	Viet Nam

OPHTHALMIC TREATMENT

This invention relates to ophthalmic treatment and more particularly, to dosage forms useful in such treatment. The invention is concerned only with liquid treatment substances.

Ocular medication is most frequently administered as eye drop solutions. The typical volume of an eye drop has been found to range from 25 μl to 50 μl. Under normal conditions, in the open eye the human tear volume remains relatively constant at around 7 μl, with continuous drainage of tear fluid (via the nasolacrimal canal) being replaced by the tear glands. The tear volume can increase to about 30 μl before overflowing occurs and the excess fluid is lost either through the nasolacrimal duct or by spillage onto the cheek. Blinking reduces this maximal volume to say, 10 μl. Thus the addition of large volumes of liquid such as those presented in commercial eyedrops will result in the rapid elimination of the active agents from the eye with typically 80-90 % of an instilled drop being lost within one minute. Drug which drained through the highly vascular nasolacrimal duct can be absorbed into the systemic circulation as a bolus dose and therefore by-pass hepatic metabolism.

The recent use of ß-blocking agents in ophthalmology has highlighted the disadvantages associated with this rapid drainage process, with serious life threatening side-effects such as bradycardia, bronchospasm and even heart failure being induced in susceptible patients. In addition, research has also shown that the rate at which instilled solutions are drained from the eye varies directly with the instilled volume i.e.the larger the instilled volume, the more rapidly it is removed from the precorneal regions of the eye. These findings have led

to the suggestion that a higher concentration of drug in as small a volume as is practicable would be beneficial. In one study published in the American Journal of Ophthalmology 85, 1978 pp 225 to 229; Ocular bioavailability and systematic loss of topically applied ophthalmic drugs, by Thomas Patton and Michael Francoeur, it was reported that when using a 5 μl eye drop loaded with 26.1 μg of pilocarpine nitrate, the fraction of drug absorbed into the eye was 0.41 μg, leaving 25.7 μg available for potential systemic absorption. A similar calculation using a 25 μl drop loaded with 67.8 μg of pilocarpine nitrate, revealed that 0.36 μg had penetrated the eye, thus leaving 67.4 μg to be absorbed systemically. From this kind of study it can be concluded:

1. That an argument could be made for the use of smaller instilled volumes of eye drops than are normally delivered by most commercial ophthalmic droppers. Drainage loss would be minimised; contact time increased and hence the potential exists for improved drug activity.
2. Due to reduced drainage, less total volume of eye drop solution, and hence less drug need be used, therefore reducing the risk of systemic side-effects, whilst improving cost efficiency due to less wastage.

The research work referred to above is restricted to the use of ophthalmic solutions delivered as instillates. Surprisingly, we have found that the ocular bioavailability of ophthalmologically active compounds can be further enhanced by delivery to the eye in the form of a jet or stream of droplets. Particularly, we have found that smaller quantities of the same treatment liquid, when delivered in this manner can have the same or an improved pharmacological effect.

Accordingly, the present invention provides a dosage form useful in ophthalmic treatment, comprising a jet or stream of droplets of treatment fluid, the jet or each droplet having an ophthalmologically active compound in suspension or solution, normally an aqueous solution. The jet or stream can be directed or targeted at a chosen site in an eye; eg, cornea, anterior bulbar conjunctiva, posterior bulbar conjunctiva or palpebral conjunctiva where the active compound can be most readily absorbed.

While dosage forms according to the invention can be delivered vertically, under the force of gravity, preferred forms are also suitable for horizontal delivery. In such forms, the jet or each droplet is of a size sufficient to sustain its momentum in transmission from a delivery device to a target site. Preferably, the size of the jet or each droplet is sufficient to sustain its momentum along a substantially horizontal path of 5 cm in length from a discharge velocity of up to 25 m/sec from a delivery device. A typical minimum discharge velocity is 5 m/s. As a general guide jet/droplet diameters in the range 20 to 1000 μm are suitable in the practice of the invention. A typical mean diameter for these purposes is in the range 100 to 800 μm, preferably 200 to 400 μm. This narrower range is a preferred guide, and in practice may not be critical. The efficacy of this invention is not adversely affected if the mean diameter is outside of this limit.

The enhanced bioavailability of ophthalmologically active compounds in dosage forms according to the invention enables the use of even smaller total volumes of treatment fluid than proposed in the eye drop study discussed above. Typically, the total volume of treatment fluid in a dosage form according to the invention does not exceed 20 μl, preferably no greater than 10 μl, and most preferably, in the range 3 to 8 μl.

The discharge of such a small volume from a delivery device at a suitable velocity to create the jet or stream will normally beat the "blink response" and result in a high percentage of the active compound in the treatment fluid performing its intended function. In other words, the entire volume can be delivered to the chosen site on the eye before the patient blinks to disperse the received fluid.

Treatment fluid used in dosage forms of the invention can additionally contain excipients to prolong the residence time in the cul-de-sac (the conjunctival sac), and thereby further enhance bioavailability. Suitable excipients include viscosity modulators, polymers, gelling agents and thickeners.

The invention will now be described with reference to the following examples.

Example 1 EPHEDRINE

Six white New Zealand rabbits were administered with the following dosage regimen:
I → 25 μl of 1 % aqueous ephedrine hydrochloride solution (250 μg) via pipette (instillate)
II → 5 μl of 5 % aqueous ephedrine hydrochloride solution (250 μg) via pipette (instillate)
III → 5 μl of 5 % aqueous ephedrine hydrochloride solution (250 μg) in a jet/stream of droplets of diameter in the range 200 to 400 μm.

Pupil diameter measurements were determined from photographs acquired using a Pentax ME super 35 mm camera fitted with a SMC Pentax 50 mm lens and a 2x converter. An aperture setting of 12, and a shutter speed of 1/15 was employed with a film speed of ISO 400 (Kodak Gold 400). The camera was held stationary on a tripod and positioned approximately 30-40 cm from the rabbits eye. Prior to each dosing period the animals

were acclimatised to experimental conditions (constant light intensity, minimal distractions) for 20 min. The rabbits were placed in restraining boxes and settled before photographs and baseline pupil diameters were determined 5 min prior to dosing.

Pupillary diameters were determined from the developed colour prints (6 x 4) using an electronic micrometer (Digimatic Caliper, Mitutoyo Corp., Japan). Absolute pupil diameters were established by comparing the pupil diameter with a scale of known magnitude placed next to and in the same plane as the pupil prior to photography. The maximum response ratio (RR_{max}) for pupil dilation was then calculated from the photographs using the following relationship:

(RR_{max}) = (pupil diameter time t - average pupil diameter time 0) / average pupil diameter time 0. The graph of Figure 1 was then plotted of mean values of RR_{max} against time. Curves I, II, and III represent the results from use of the respective dosage regimen referred to above.

Results

It can be seen from Figure 1 that the mydriatic response obtained from the 5 μl ocular droplet dosage form was more pronounced and maintained over a longer duration compared to both instillates; in terms of RR_{max} values the response can be ranked as follows : 5 μl ocular droplet stream > 5 μl instillate > 25 μl instillate.

Instillates are normally administered directly into the conjunctival sac with reflex blinking distributing the majority of the solution over the cornea. Even with small volume instillates, a substantial proportion of the solution is still emptied directly into the nasolacrimal drainage system. In using dosage forms of the invention targeted directly at the cornea our results showed that the solution uniformly covered the cornea with minimal splash-back upon impact, with a

gradual pooling of liquid towards the conjunctival sac. Blinking in these instances distributed the solution over the corneal surface even further. This comparative study clearly shows that small volume ophthalmic solutions delivered in a droplet stream enhanced the bioavailability of ephedrine in comparison to the instillate presented from many commercial eyedroppers. A similar effect would be expected using other ophthalmic drugs.

Example 2 PILOCARPINE HCl

Ten white New Zealand rabbits were treated with the following dosage regimen in a randomised cross-over study:

30 μl of 1 % aqueous pilocarpine hydrochloride solution (300 μg) was instilled via pipette into the conjunctival sac 5 μl of 1 % aqueous pilocarpine hydrochloride solution (50 μg) was applied as a jet and/or stream of droplets (with a diameter in the range of 200 μm to 400 μm) to the surface of the cornea.

In order to determine pupil diameters, a metallic rule with a circular aperture of known diameter was orientated perpendicular to, and at an appropriate fixed distance from, a video camera fitted with a macro lens (Sony V8 Pro-CDD-V100E) throughout the study. During miotic measurements, the animals were positioned such that the left eye was parallel to the ruler and equidistant from the video camera. The video camera was actuated to project and amplify images of both the reference aperture and left eye onto the monitor screen. The diameters of both the reference aperture and pupil were then measured on the screen using a ruler placed on the projected image at an angle of approximately 135-305 degrees. The value of the pupil diameter was then calculated by multiplying the projected screen pupil

diameter by the ratio of the actual reference diameter (8 mm) to the projected screen reference diameter (18 mm).

Pupil measurements were taken at approximately 60, 45, 30 and 15 minute intervals prior to administration of the treatments to provide a baseline value, and then at 15 minute intervals for the first hour after dosing. Thereafter, the pupil diameter was measured at 30 minute intervals for a minimum duration of 4 hours after dose administration.

For the purpose of statistical analysis of variants between treatments, the following parameters were determined: RR max = (pupil diameter at time t - pupil diameter at time 0) / pupil diameter at time 0; T max = the first time point at which the smallest pupillary diameter was observed; and AUC (0-4 hours) = the area under the pupillary diameter vs. time curve between 0 and 4 hours after treatment.

All significance tests were two-tailed and were performed at the 5 % significance level. The statistical software SAS V607 and the PROC GLM procedure were used in the analysis.

Results

Pupil diameter measurements were taken over the time course of the experiments. Some variation in the pupil diameter could be seen in the predose data, with a significant (P=0.0001) decrease in mean diameter being observed for both treatments as a function of time. The Shapiro-Wilk test for normality revealed that the errors associated with the pupil diameter readings were independently and normally distributed. Pupil diameter measurements were also taken following pilocarpine administration. A reduction in pupil diameter was evident for both dose forms after 15 minutes. However, this effect started to disappear approximately 60-90

minutes after treatment and, after 120 minutes, the measurements had fully recovered to their predose levels.

Pilocarpine Treatment	AUC (0-4hours) mmMin.	T max Min.	RR max %
1 % 30 µl large eyedrop (300 µg)	3871 ± 340*	25.5 ± 12.5*	15.2 ± 4.0*
1 % 5 µl jet and/or stream of droplets (50 µg)	3827 ± 312*	24.0 ± 23.7*	12.3 ± 5.2*

* standard deviations of the mean

The table compares the two treatments in terms of their effects on RR max, T max and AUC. There was no statistically significant difference in the calculated values of RR max, T max or AUC between either of the treatments. Thus, this work demonstrates that an ophthalmic dosage form comprised of a jet and/or stream of droplets can produce an equivalent pharmacodynamic effect to a standard eyedrop with only 1/6 of the drug.

Example 3 PROPRANOLOL HCl (Ocular distribution study)

40 µl of 0.5 % aqueous tritiated propranolol hydrochloride solution (200 µg) was administered via pipette into the conjunctival sac of twelve New Zealand white rabbit eyes. Seperately, 5 µl of 4 % aqueous tritiated propranolol hydrochloride solution (200 µg) was applied as a jet or stream of droplets (with a diameter in the range of 200 µm to 400 µm) to the surface (cornea and/or conjunctiva) of twelve different New Zealand white rabbit eyes.

Following each treatment, four eyes were ennucleated after

15 minutes, four after 30 minutes and the remaining four after 60 minutes. In each case, the animals were humanely killed prior to the ocular ennucleation procedure via an overdose of sodium pentobarbitol injected into a marginal ear vein. Each eye was then irrigated by instilling 100 μl of normal saline into the conjunctival sac using an automatic pipette and immediately blotting away excess saline with paper tissue to remove any radioactivity in the tear film. Following ennucleation and removal of the adnexal tissue, the cornea was washed with a second 100 μl of normal saline. The aqueous humor was then quickly removed by paracentesis with a 1 ml syringe and 26G needle. To this was then added an equal volume of trichloroacetic acid (TCA) solution (10 % w/v) to bring the final concentration to 5 % w/v TCA. Both eyes were then dissected from the posterior pole to allow removal of the vitreous humor and the lens, whilst the iris-cilary body was transferred to a tared sample tube. The cornea was then removed using a 12 mm trephine, and the limbal cornea and conjunctiva (with underlying sclera) cut free into a strip approximately 5 mm wide using a scalpel and scissors. Each sample was then weighed in a tared sample tube and at least 5 volumes of TCA (6 % w/v) added. All tissue samples were subjected to sonication for 5 minutes, then centrifuged at 10 000 g.min. to yield a supernatent. Each supernatent was then extracted 3 times with 3 volumes of ether and, after evaporation of residual solvent, the aqueous residue was sampled and added to 5 ml of FluoronSafe XE "Scintron" scintillation fluid (BDH Chemicals, UK). Radioactivity was then determined by counting in a Packard 1600DR beta-scintillation counter. Data gathered as counts per minute was then converted into disintegrations per minute (dpm), using external standardisation, and expressed as dpm per g of tissue after adjusting for the total radioactivity in each dose. Due to the small number of samples per time point per treatment, statistical analysis was not considered

appropriate for this study.

Results

The results of this study are summarised for the different ocular tissues in tables 1 to 4 below, where the values shown represent dpm (disintegrations per minute) per mg of tissue.

Table 1: Cornea

Propranolol Treatment	15 mins	30 mins	60 mins
0.5 % 40 µl large eyedrop (200 µg)	5579	3467	2945
4.0 % 5 µl jet and/or stream of droplets (200 µg)	5241	3766	1861

Table 2: Conjunctiva/sclera

Propranolol Treatment	15 mins	30 mins	60 mins
0.5 % 40 µl large eyedrop (200 µg)	2569	2838	1380
4.0 % 5 µl jet and/or stream of droplets (200 µg)	5286	2259	1673

Table 3: Aqueous humor

Propranolol Treatment	15 mins	30 mins	60 mins
0.5 % 40 µl large eyedrop (200 µg)	1310	960	705
4.0 % 5 µl jet and/or stream of droplets (200 µg)	1845	1176	607

Table 4: Iris-cilary body

Propranolol Treatment	15 mins	30 mins	60 mins
0.5 % 40 µl large eyedrop (200 µg)	942	1033	799
4.0 % 5 µl jet and/or stream of droplets (200 µg)	2256	1482	586

Significant radioactivity was detected in all ocular tissues at all time points for both treatments.

Following dose administration the drug will initially be absorbed into either the cornea or conjunctiva. It would then be expected to partition into the aqueous humor and finally reach the iris-cilary body, which is the site of action for an ophthalmic beta blocker. The concentration of drug in this tissue is therefore of paramount importance in terms of clinical efficacy, i.e. intra-ocular pressure (IOP) reduction. Moreover, recent literature reports (ref: S.A. Sadiq and S.A. Vernon, British Journal of Ophthalmology. 1996 Vol. 80, pp. 532-535) with the most widely used ophthalmic beta blocker, timolol maleate, suggest that the rate at which drug saturates the ocular beta-adrenoceptors in the iris-cilary body is also of considerable importance in terms of clinical efficacy. The rationale here is that rapid heavy blockade of the receptor sites maximises inhibition of aqueous humor secretion and, therefore, IOP reduction.

This fact is of considerable importance when interpreting the results from the present study. Thus, the level of propranolol reaching the iris-ciliary body early (i.e. at the 15 minute time point) from the jet and/or stream of droplets was more than double that obtained from the eyedrop. Such a rapid and substantial accumulation of the beta blocker at its target site would be expected to produce a marked benefit in terms of beta-adrenoceptor inhibition and, therefore, IOP reduction. The comparatively higher level of radioactivity in the iris-cilary body from the eyedrop after 60 minutes probably reflected re-absorption from the local vasculature.

The concentrations of propranolol in the other tissues are not directly relevant from a therapeutic viewpoint, as the iris-cilary body is the only site of aqueous humor formation in the eye. Therefore, although the concentrations of propranolol in some of these other

tissues are higher at certain timepoints from the eyedrop compared to the other dosage form, this is unlikely to be of direct relevance to the levels of beta-adrenoceptor inhibition and, therefore, the suppression of aqueous humor formation.

Ophthalmic treatment liquids that may be used with the invention may be aqueous or non-aqueous liquids, optionally containing a therapeutic compound or compounds such as:

1) Anti-glaucoma/IOP (intra-ocular pressure) lowering compounds

a) ß-adrenoceptor antagonists, e.g. carteolol, cetamolol, betaxolol, levobunolol, metipranolol, timolol, etc.

b) Miotics, e.g. pilocarpine, carbachol, physostigmine, etc.

c) Sympathomimetics, e.g. adrenaline, dipivefrine, etc.

d) Carbonic anhydrase inhibitors, e.g. acetazolamide, dorzolamide, etc.

e) Prostaglandins, e.g. PGF-2 alpha and derivatives thereof such as latanoprost.

2) Anti-microbial compounds (including anti-bacterials and anti-fungals), e.g. chloramphenicol, chlortetracycline, ciprofloxacin, framycetin, fusidic acid, gentamicin, neomycin, norfloxacin, ofloxacin, polymyxin, propamidine, tetracycline, tobramycin, quinolines, etc.

3) Anti-viral compounds, e.g. acyclovir, cidofovir, idoxuridine, interferons, etc.

4) Aldose reductase inhibitors, e.g. tolrestat, etc.

5) Anti-inflammatory and/or anti-allergy compounds, e.g.

steroidal compounds such as betamethasone, clobetasone, dexamethasone, fluorometholone, hydrocortisone, prednisolone etc. and non-steroidal compounds such as antazoline, bromfenac, diclofenac, indomethacin, lodoxamide, saprofen, sodium cromoglycate, etc.

6) Artificial tear/dry eye therapies, comfort drops, irrigation fluids, etc., e.g. physiological saline, water, or oils; all optionally containing polymeric compounds such as acetylcysteine, hydroxyethylcellulose, hydroxymellose, hyaluronic acid, polyvinyl alcohol, polyacrylic acid derivatives, etc.

7) Diagnostics, e.g. fluorescein, rose bengal, etc.

8) Local anaesthetics, e.g. amethocaine, lignocaine, oxbuprocaine, proxymetacaine, etc.

9) Compounds which assist healing of corneal surface defects, e.g. cyclosporine, diclofenac, urogastrone and growth factors such as epidermal growth factor, etc.

10) Mydriatics and cycloplegics e.g. atropine, cyclopentolate, homatropine, hysocine, tropicamide, etc.

11) Compounds for the treatment of pterygium, such as mitomycin C, collagenase inhibitors (e.g. batimastat) etc.

12) Compounds for the treatment of macular degeneration and/or diabetic retinopathy and/or cataract prevention.

13) Compounds for systemic effects following absorption into the bloodstream after ocular administration, e.g. insulin.

The above compounds may be in the form of free acids or bases or alternately as salts of these. Combinations

of compounds e.g. an anti-bacterial combined with an anti-flammatory may be desirable for the optimization of therapy in some instances. The compounds may be formulated as aqueous or non-aqueous (e.g. oil) solutions or suspensions. Formulations may optionally contain other formulation excipients, for example, thickening agents such as gels, mucoadhesives and polymers, stabilisers, anti-oxidants, preservatives, pH/tonicity adjusters etc.

Devices suitable for delivering dosage forms in accordance with the present invention are described in our International Patent Application Nos. GB95/01482 and GB95/02040, now publication Nos. WO96/00050 and WO96/06581, to which reference is directed.

CLAIMS

1. A dosage form useful in ophthalmic treatment comprising a jet or stream of droplets of treatment fluid, each droplet having an ophthalmologically active compound in suspension or solution.

2. A dosage form according to Claim 1 wherein the jet or each droplet has the active compound in aqueous suspension or solution.

3. A dosage form according to Claim 1 or Claim 2 wherein the jet or each droplet is of a size sufficient to sustain its momentum in transmission from a delivery device to a target site.

4. A dosage form according to Claim 3 wherein the jet or each droplet is of a size sufficient to sustain momentum along a substantially horizontal path 5 cms in length from a discharge velocity of up to 25 m/sec from the delivery device.

5. A dosage form according to any preceding Claim wherein the jet or each droplet has a diameter in the range 100 to 800 μm.

6. A dosage form according to Claim 5 wherein the jet or each droplet has a diameter in the range 200 to 400 μm.

7. A dosage form according to any preceding Claim in which the total volume of treatment fluid does not exceed 10 μl.

8. A dosage form according to Claim 7 in which the total volume of treatment fluid is in the range 3 to 8 μl.

9. A method of ophthalmic treatment comprising delivering to an eye a dosage form according to any preceding Claim.

10. A method according to Claim 9 wherein the eye is a human eye.

11. A method according to Claim 9 or Claim 10 wherein the dosage form is directed at a particular site in the eye.

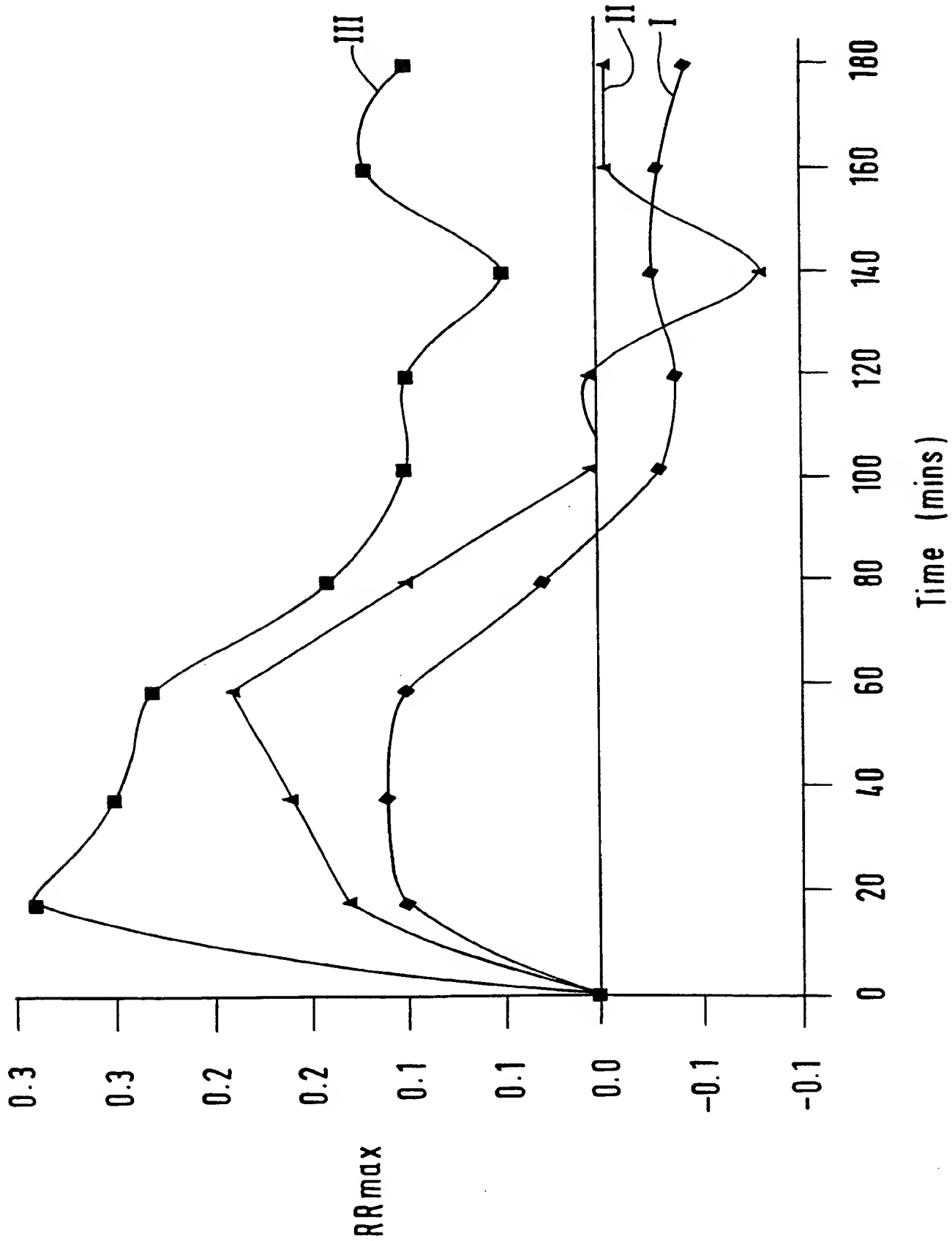
12. A method of increasing the ocular

bioavailability of ophthalmologically active compound, wherein the compound is provided in suspension or solution in a body of ophthalmic treatment liquid in a dosage form comprising the liquid as a jet and/or stream of droplets, the jet and/or droplets having a mean diameter in the range 20 μm to 1000 μm.

13. A method according to Claim 12 wherein the mean diameter of the jet and/or droplets is in the range 100 μm to 800 μm, preferably 200 μm to 400 μm.

14. A method according to Claim 12 or Claim 13 wherein the total volume of treatment liquid in the dosage form does not exceed 10 μl.

15. A method according to Claim 14 wherein the total volume of treatment liquid in the dosage form is in the range 3 μl to 8 μl.


III
II
I
0.3
0.3
0.2
0.2
0.1
0.1
0.0
-0.1
-0.1
RRmax
0
20
40
60
80
100
120
140
160
180
Time (mins)

INTERNATIONAL SEARCH REPORT

[redacted]rnational application No.
PCT/GB 96/03195

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: 9-11
because they relate to subject matter not required to be searched by this Authority, namely:
SEE RULE 39.1 (iv) PCT

2. [ ] Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. [ ] As all searchable claims could be searches without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest.

[ ] No protest accompanied the payment of additional search fees.